PATENT
0503-1009

IN THE U.S. PATENT AND TRADEMARK OFFICE

In re application of: Olivier MATILE

Appl. No.: NEW Group:

Filed: February 20, 2002 Examiner:

For: LASER CUTTING METHOD AND APPARATUS WITH A BIFOCAL OPTICAL MEANS AND A HYDROGEN-BASED ASSIST GAS

10075950.022002

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, DC 20231

February 20, 2002

Sir:

The following preliminary amendments and remarks are respectfully submitted in connection with the above-identified application.

IN THE ABSTRACT OF THE DISCLOSURE:

Please replace the Abstract of the Disclosure with the rewritten Abstract of the Disclosure attached on a separate sheet attached hereto.

IN THE CLAIMS:

Please amend the claims as follows:

3. (Amended) Method according to claim 1, characterized in that the workpiece to be cut is made of stainless steel, coated

steel, aluminium or aluminium alloy, non-alloy steel or alloy steel.

4. (Amended) Method according to claim 1, characterized in that the inert gas is chosen from nitrogen, argon, helium and mixtures thereof, preferably the inert gas being chosen from nitrogen, argon and mixtures thereof.

5. (Amended) Method according to claim 1, characterized in that the assist gas contains from 150 ppm by volume to 40% by volume of hydrogen, preferably from 0.5% by volume to 30% by volume of hydrogen, the balance being the inert gas.

6. (Amended) Method according to claim 1, characterized in that the assist gas consists of 5% by volume to 30% by volume of hydrogen, the balance being nitrogen.

7. (Amended) Method according to claim 1, characterized in that the thickness of the workpiece to be cut is between 0.2 mm and 20 mm, typically between 0.3 mm and 16 mm.

8. (Amended) Method according to claim 1, characterized in that the cutting speed is between 0.5 m/min and 20 m/min.

9. (Amended) Method according to claim 1, characterized

in that the optical means is arranged so as to obtain at least one first focal point positioned near the upper surface of the workpiece to be cut, preferably so as to coincide with the said upper surface, or in the thickness of the workpiece to be cut in a region close to the said upper surface, and at least one second focal point positioned near the lower surface of the workpiece to be cut and in the thickness of the latter, or outside the latter.

10. (Amended) Method according to claim 1, characterized in that the assist gas contains hydrogen in an amount adjusted according to the thickness and/or the constituent material of the workpiece to be cut.

11. (Amended) Laser beam cutting apparatus for implementing a method according to claim 1, comprising:

- at least one laser generator for generating at least one laser beam;
- at least one cutting nozzle with at least one laser beam inlet and at least one laser beam outlet;
- at least one transparent or reflecting optical means of the multifocus type for focusing the said laser beam at several focal points; and
- at least one source of assist gas containing hydrogen and at least one inert gas for the said laser

beam and for feeding the said nozzle with the said assist gas.

12. (Amended) Laser beam cutting apparatus for implementing a method according to claim 1, comprising :

- at least one laser generator for generating at least one laser beam;
- at least one cutting nozzle with at least one laser beam inlet and at least one laser beam outlet;
- at least one transparent or reflecting optical means of the multifocus type for focusing the said laser beam at several focal points;
- at least a first source of gas containing at least hydrogen;
- at least a second source of gas containing at least one inert gas; and
- gas mixing means for mixing the gas coming from the first gas source with gas coming from the second gas source so as to obtain an assist gas for the said laser beam containing hydrogen and at least one inert gas, the said assist gas feeding the said nozzle.

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REMARKS

Claims 1-12 are pending in the present application.

Entry of the above amendments is earnestly solicited. An early and favorable first action on the merits is earnestly requested.

Should there be any matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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BC/ma
Attachments

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE ABSTRACT OF THE DISCLOSURE:

The Abstract of the Disclosure has been amended as follows:

ABSTRACT

Apparatus and method for cutting a workpiece by the use of a laser beam and an assist gas, in which at least one optical ~~means~~element is used to focus the laser beam at several focal points separate from one another, and in which, as assist gas for the~~said~~ laser beam, a gas mixture containing hydrogen and at least one inert gas is used. The optical ~~means~~element is transparent or reflecting and is chosen from lenses, mirrors and combinations thereof, preferably a bifocal lens. The workpiece to be cut is made of stainless steel, coated steel, ~~aluminium or an aluminium~~aluminum or an aluminum alloy, non-alloy steel or alloy steel. The inert gas is chosen from nitrogen, argon, helium and mixtures thereof.

IN THE CLAIMS:

The claims have been amended as follows:

3. (Amended) Method according to ~~either of Claims 1 and 2,~~claim 1, characterized in that the workpiece to be cut is made of stainless steel, coated steel, aluminium or aluminium alloy, non-alloy steel or alloy steel.

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4. (Amended) Method according to ~~one of Claims 1 to 3,~~ claim 1, characterized in that the inert gas is chosen from nitrogen, argon, helium and mixtures thereof, preferably the inert gas being chosen from nitrogen, argon and mixtures thereof.

5. (Amended) Method according to ~~one of Claims 1 to 4,~~ claim 1, characterized in that the assist gas contains from 150 ppm by volume to 40% by volume of hydrogen, preferably from 0.5% by volume to 30% by volume of hydrogen, the balance being the inert gas.

6. (Amended) Method according to ~~one of Claims 1 to 5,~~ claim 1, characterized in that the assist gas consists of 5% by volume to 30% by volume of hydrogen, the balance being nitrogen.

7. (Amended) Method according to ~~one of Claims 1 to 6,~~ claim 1, characterized in that the thickness of the workpiece to be cut is between 0.2 mm and 20 mm, typically between 0.3 mm and 16 mm.

8. (Amended) Method according to ~~one of Claims 1 to 7,~~ claim 1, characterized in that the cutting speed is between

0.5 m/min and 20 m/min.

9. (Amended) Method according to ~~one of Claims 1 to 8,~~claim 1, characterized in that the optical means is arranged so as to obtain at least one first focal point positioned near the upper surface of the workpiece to be cut, preferably so as to coincide with the said upper surface, or in the thickness of the workpiece to be cut in a region close to the said upper surface, and at least one second focal point positioned near the lower surface of the workpiece to be cut and in the thickness of the latter, or outside the latter.

10. (Amended) Method according to ~~one of Claims 1 to 9,~~claim 1, characterized in that the assist gas contains hydrogen in an amount adjusted according to the thickness and/or the constituent material of the workpiece to be cut.

11. (Amended) Laser beam cutting apparatus for implementing a method according to ~~one of Claims 1 to 10,~~claim 1, comprising:

- at least one laser generator for generating at least one laser beam;
- at least one cutting nozzle with at least one laser beam inlet and at least one laser beam outlet;

- at least one transparent or reflecting optical means of the multifocus type for focusing the said laser beam at several focal points; and
- at least one source of assist gas containing hydrogen and at least one inert gas for the said laser beam and for feeding the said nozzle with the said assist gas.

12. (Amended) Laser beam cutting apparatus for implementing a method according to ~~one of Claims 1 to 10,~~claim 1, comprising :

- at least one laser generator for generating at least one laser beam;
- at least one cutting nozzle with at least one laser beam inlet and at least one laser beam outlet;
- at least one transparent or reflecting optical means of the multifocus type for focusing the said laser beam at several focal points;
- at least a first source of gas containing at least hydrogen;
- at least a second source of gas containing at least one inert gas; and
- gas mixing means for mixing the gas coming from the first gas source with gas coming from the second gas source so as to obtain an assist gas for the said laser beam containing

hydrogen and at least one inert gas, the said assist gas feeding the said nozzle.

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ABSTRACT

Apparatus and method for cutting a workpiece by the use of a laser beam and an assist gas, in which at least one optical element is used to focus the laser beam at several focal points separate from one another, and in which, as assist gas for the laser beam, a gas mixture containing hydrogen and at least one inert gas is used. The optical element is transparent or reflecting and is chosen from lenses, mirrors and combinations thereof, preferably a bifocal lens. The workpiece to be cut is made of stainless steel, coated steel, aluminum or an aluminum alloy, non-alloy steel or alloy steel. The inert gas is chosen from nitrogen, argon, helium and mixtures thereof.